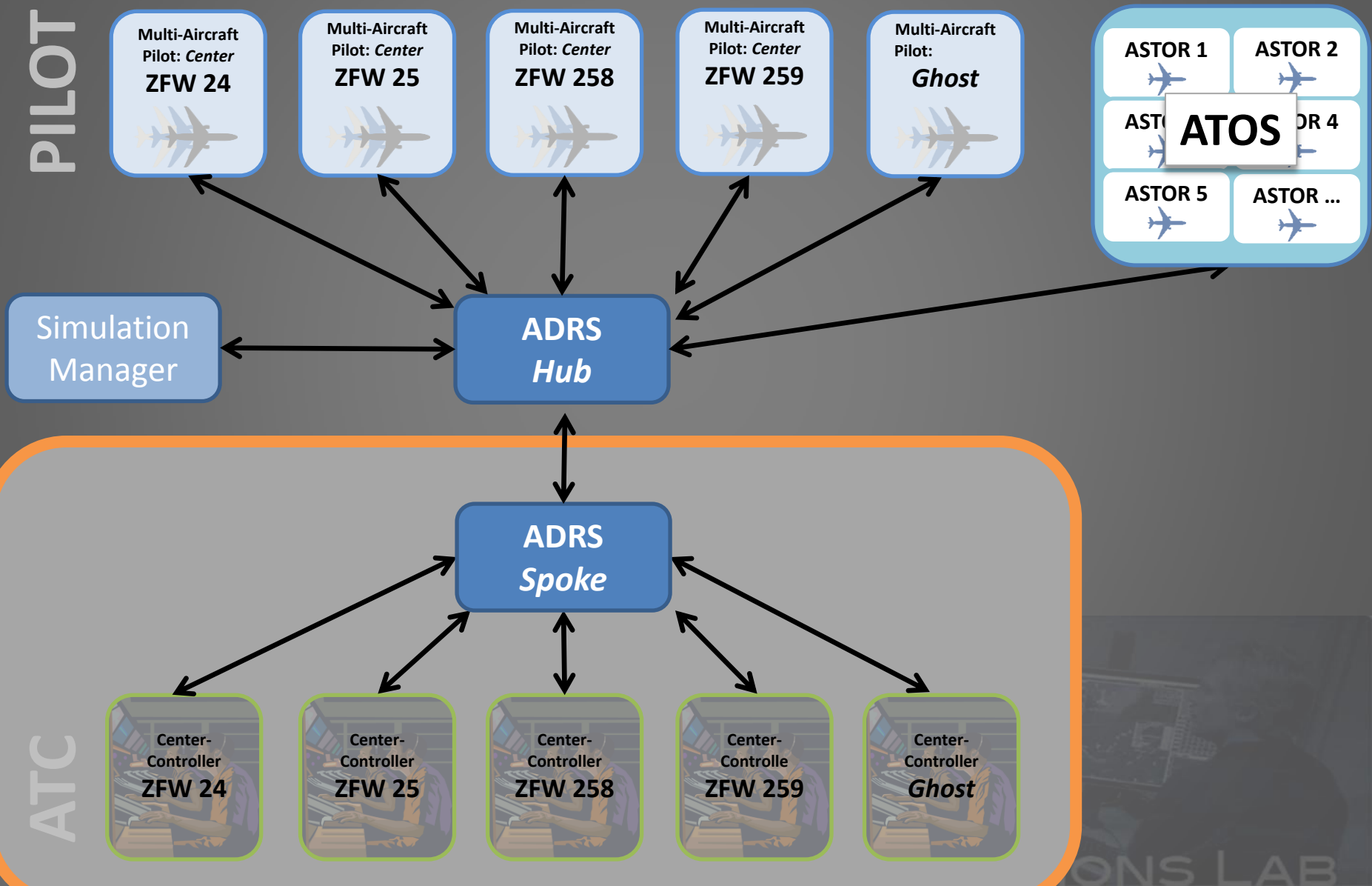
Tuesday (01/10/2012)
Briefings

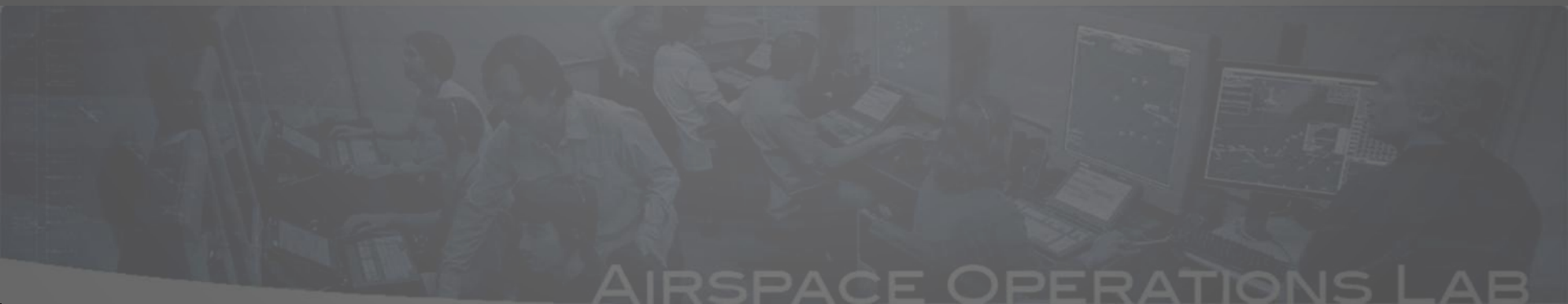
08:30	Intro and MACS Overview
09:40	Break
10:00	MACS/ADRS simulation architecture and integration with ATOS and TMA
11:00	Using MACS to simulate aircraft operations *Simulation Manager and Flight Deck Stations*
12:00	Lunch
1:00	Basic Air Traffic Control Operations.
1:30	Using MACS to simulate near-term air traffic control operations. *Focus ATD-1, Center/TRACON workstations, Scheduling, CMS*
2:45	Break
3:00	Using MACS to simulate far-term automated air traffic control operations. *Focus on Separation Assurance*
3:45	Developing MACS Software
4:30	End of day

Separation Assurance/Function allocation simulation components. MACS pilot and controller stations for en route, ATOS (in preparation)



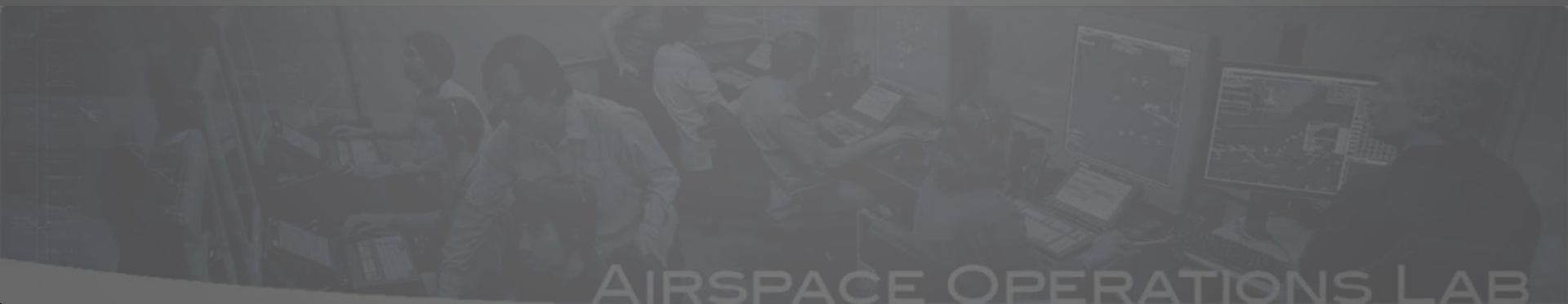
Using MACS to simulate far-term automated air traffic control operations.
Focus on Separation Assurance

Tom Prevot



Overview

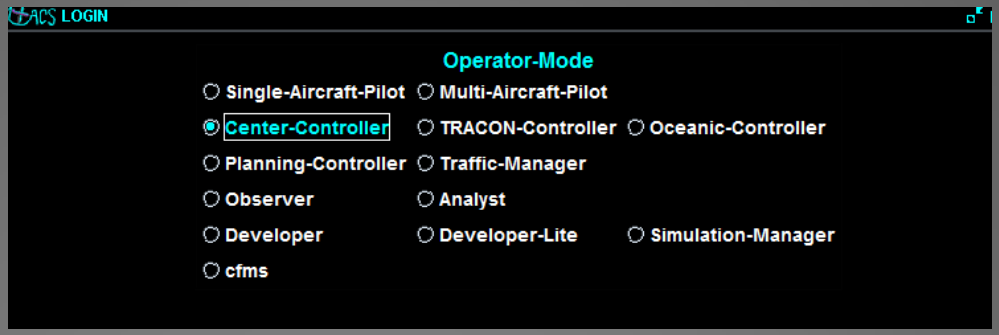
- Enroute controller stations in the mid-term
- Automated enroute controller stations in the far-term



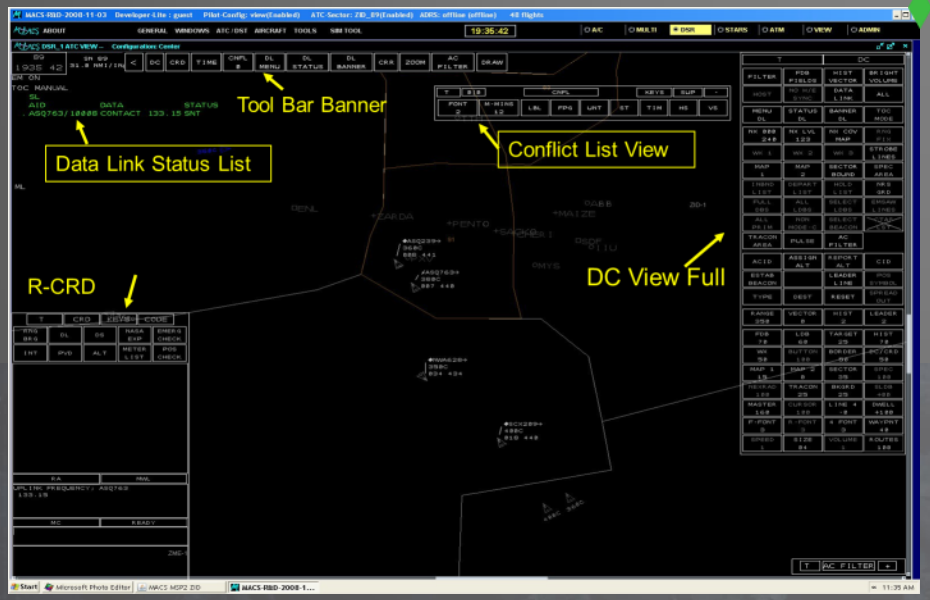
Air Traffic Control

En Route Controller Positions

Operator-Mode:
Center-Controller



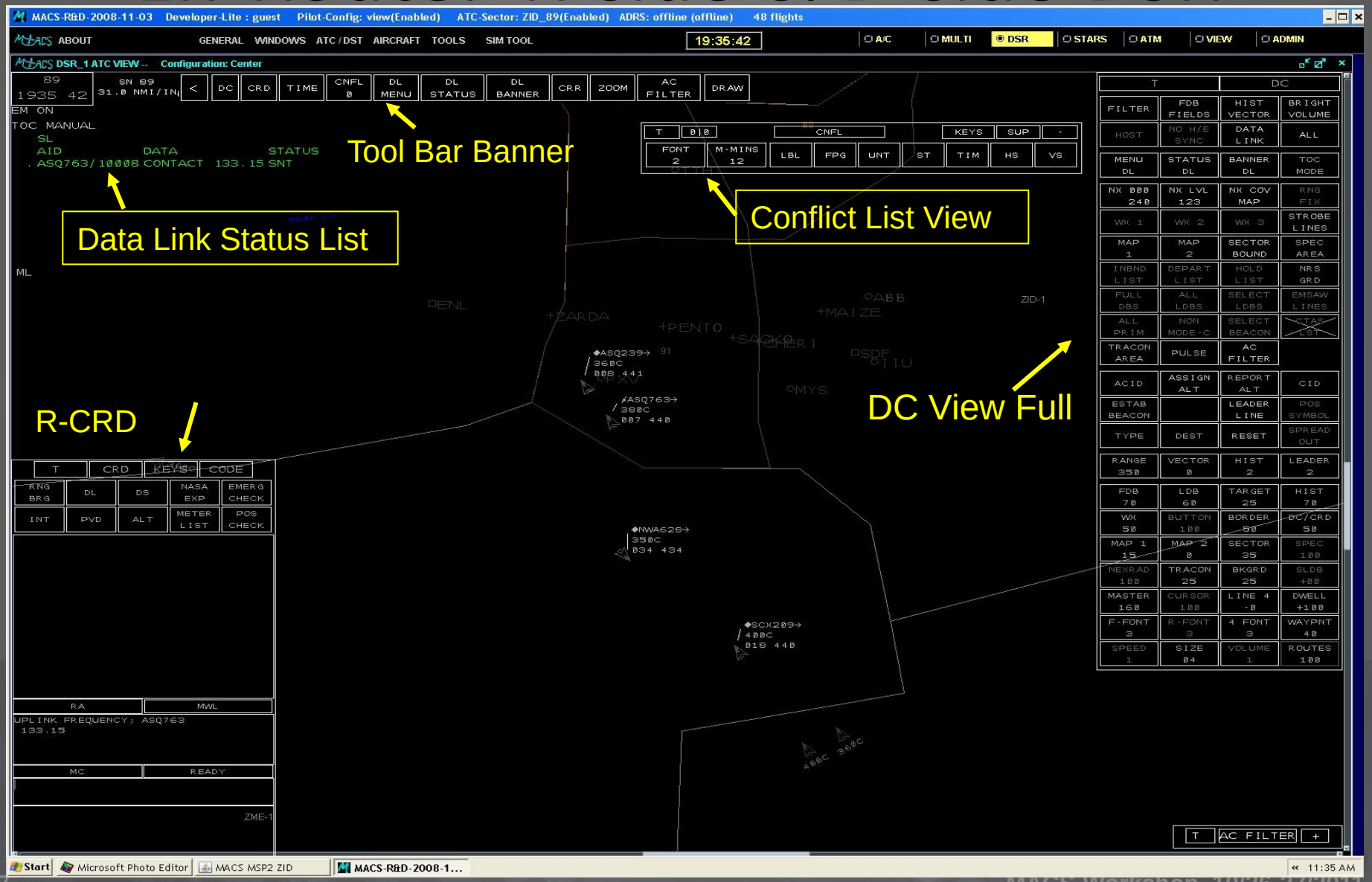
Primary Display:
DSR View
DSR: Display System Replacement



Most Relevant Setup Files:

- ATC DST Configuration
- ATC DST Sector Configuration
- DSR Data Tag Rules Setup
- DSR Plan View Setup
- DSR Sector Plan View Setup
- DSR Timeline Setup

En-Route: R-side & D-side DSR



Mid-Term Controller Tools

- 4D trajectory generation for flight plan routing, scheduling, reported FMS trajectories, ADS-B reported state and flight control system targets
- Arrival scheduler and timelines
- Medium-term Conflict detection
- Trial planning and speed advisory functions for metering support
- Automation for automatic transfer of communication and RTA uplinks
- Multi-layered rapid feedback conflict probing
- Weather penetration probe
- Data comm. integration
- Fully automated, semi-automated, manual operations
- AAC Auto-Resolver with Weather avoidance

- Most functions are configured via the ATC DST Configuration

Conflict Probe FDB

Flight Data Block Conflict Information

Font Color Coding for Time-to-Conflict values

- Red Font: time-to-loss of separation is < 3 minutes
- Yellow Font: time-to-loss of separation is > 3 minutes ≤ 5 minutes
- White Font: time-to-loss of separation is > 5 minutes but < 12 minutes

Trial Planning

- Trial Plan Options
  - Single or Multi-Aircraft
  - Typed Commands into DSR CRD
    - FF- selects aircraft for group trial planning
    - TT- opens basic route trial plan
    - TA- opens an altitude trial plan
    - TR- opens a more specified route trial plan
  - Interactive Flight Data Block (FDB)
    - Arrow next to the aircraft call sign- opens basic route trial plan
    - Same arrow (but magenta-colored)- to review a suggested trial plan
    - Altitude line of the FDB- opens an altitude trial plan
    - Conflict number to start a automated trial plan resolution to solve for the predicted traffic conflict
    - Weather number to start a trial plan to solve for the predicted weather penetration
  - Drag and Drop Route Line
    - Lat/Long
    - Waypoint

Multiple Aircraft Trial Plan- FF

FDB Trial Plan Portal

Air/Ground Data Communication

Key Uplink Capabilities

- Trajectory information [or parameters] and trajectory constraints (route modification uplinks, altitudes, profile speeds, required times of arrival)
- transfer of communication (i.e. frequency changes)
- free text (encode anything in text format)
- responses to aircraft initiated requests

Key Downlink capabilities

- Responses (wilco, reject)
- Free text (encode anything in text format)
- Requested trajectory changes

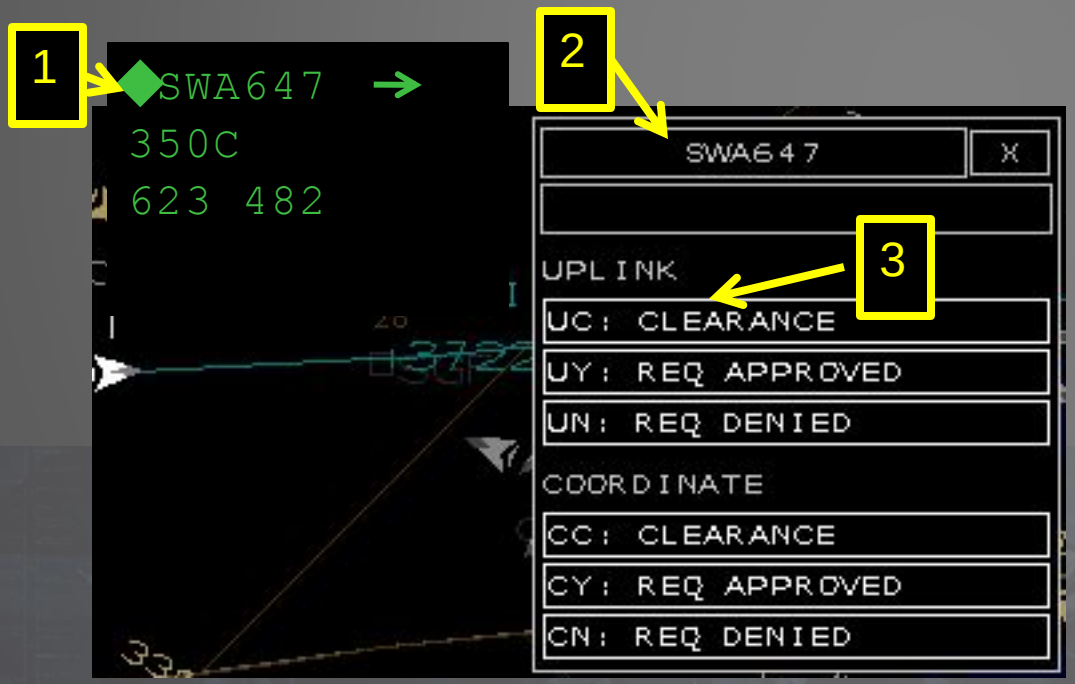
Broadcast/ downlink capabilities

- Aircraft state and velocities
- Short term intent and flight modes (i.e. flight control system settings)
- FMS trajectory reports
- FMS inputs (e.g. speed profile, weight)

Data Comm: Mixed Equipage

Equipped Data Comm Clearance

Uplink Clearance to Aircraft (Point and Click)
1. Pick on data link portal (filled triangle)
2. Drop down box appears next to FDB
3. Pick on UC: Clearance to uplink to aircraft



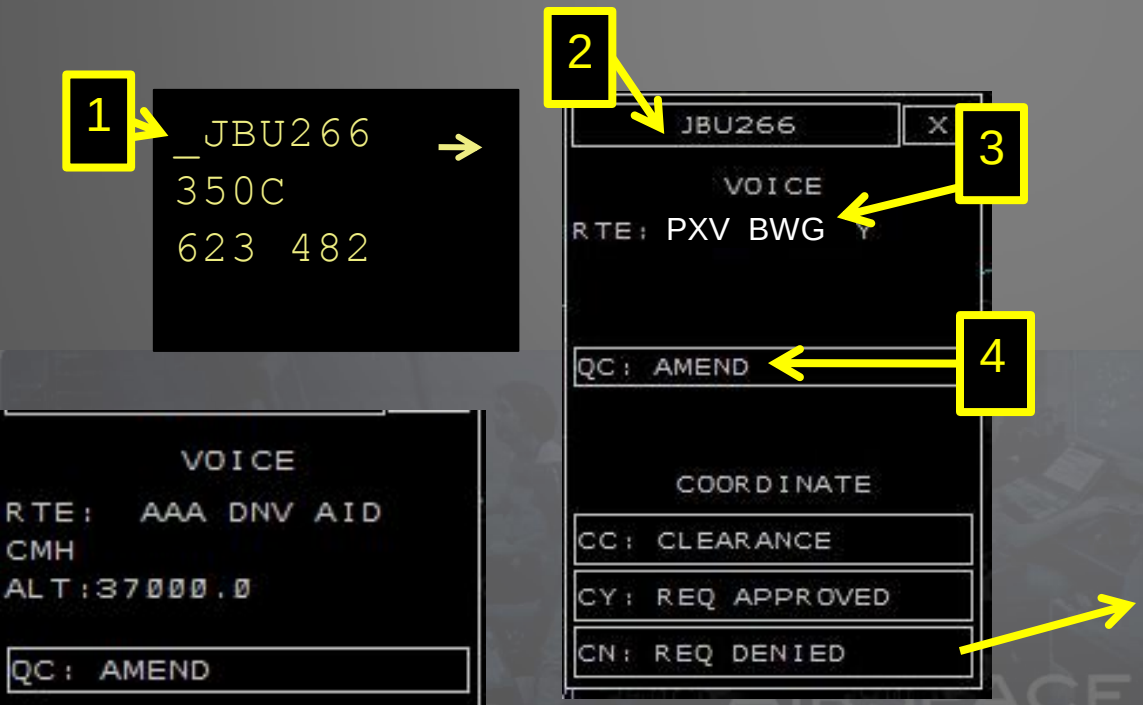
Uplink Clearance via Keyboard
- Type UC [CID] ENTER

Data Comm: Mixed Equipage

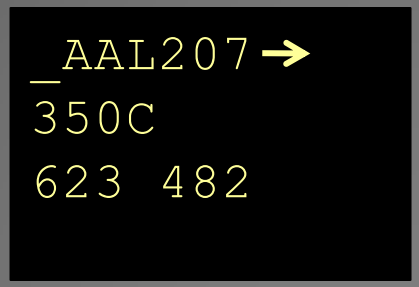
Un-Equipped Verbal Clearance

Issue TP or CC Clearance to Aircraft (Point and Click)

1. Pick on data link portal (underscore symbol)
2. Drop down box appears next to FDB
3. Voice clearance appears, issue to aircraft Direct PXV, BWG rest of route unchanged
4. Pick on QC: Amend in Automation (HOST)



Data Comm FDB Information



status the following data link status symbols are found in the flight data block (left of the call sign):

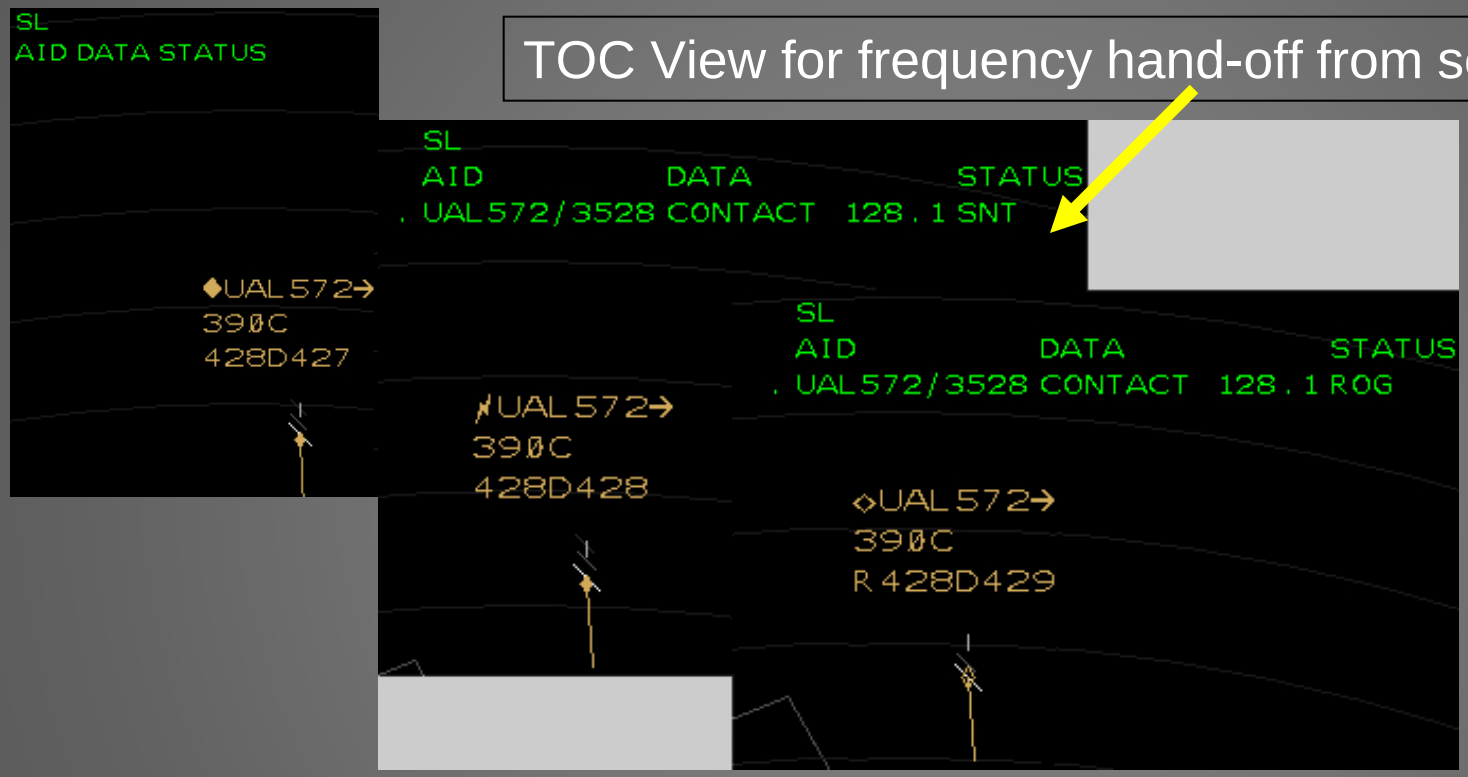
symbols : eligibility : no eligibility : TOC in progress : uplink in progress

: coordination request (right of callsign)

- A filled diamond ( ) indicates that the sector has "eligibility", and can send and receive messages to the aircraft. Data link eligibility usually accompanies track control, but the transfer mechanism is separate.
- An unfilled diamond ( ) indicates that the sector does not have "eligibility" (i.e., cannot communicate with this aircraft via CPDLC).
- A lightning bolt ( ) indicates that a transfer of communication (and transfer of eligibility) is in progress.
- An up arrow ( ) indicates that a message has been "uplinked" from the controller to the aircraft. The uplink may be a clearance, frequency, or text message.
- A magenta arrow ( ) indicates a coordination request which is a clearance request sent to the CPDLC eligible controller from another ground position or MSP.

Sample Data Comm Transfer of Communication (Air-to-Ground)

TOC View for frequency hand-off from sending sector:



TOC View for accepting hand-off frequency change from receiving sector:

Multi Aircraft Control System (MACS)

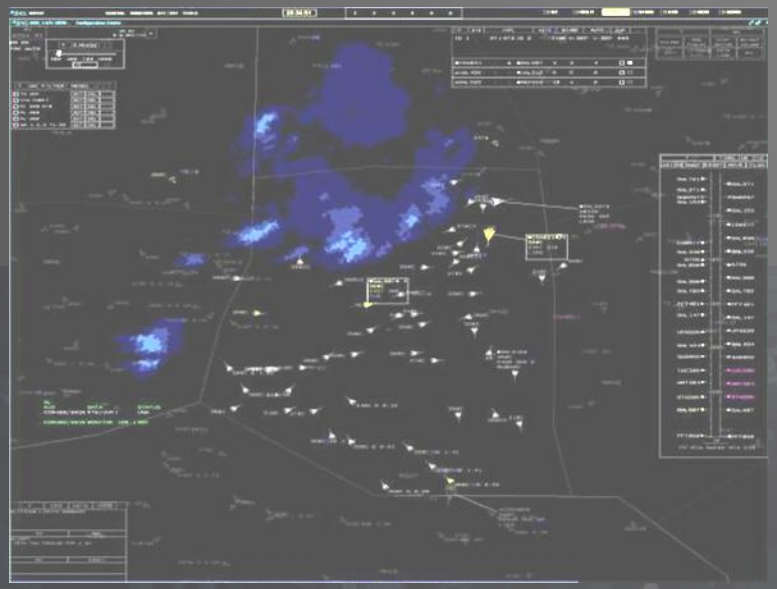
AIR TRAFFIC CONTROL OPERATIONS FAR-TERM / 2030

30, 40, or 50 aircraft are allowed in Airspace “sectors” at any given time
1 or 2 Air Traffic Controllers per sector possible
Video shows 8 controllers handling ~300 aircraft

Air Traffic Control in 2030 …

Function Allocation used in Study

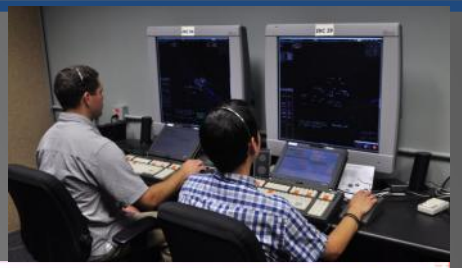
Automation	Controller
•Detect Separation and weather Conflicts •Resolve trajectory-based conflicts (if within tolerances) •Resolve all time-critical traffic conflicts •Alert controller to urgent problems •Provide trajectory planning assistance •Use data comm. to communicate	•Supervise the automation •Resolve trajectory conflicts flagged by the automation •Monitor and maintain schedule compliance •Implement weather reroutes with automation support •Place aircraft back on trajectory following automated tactical maneuvers

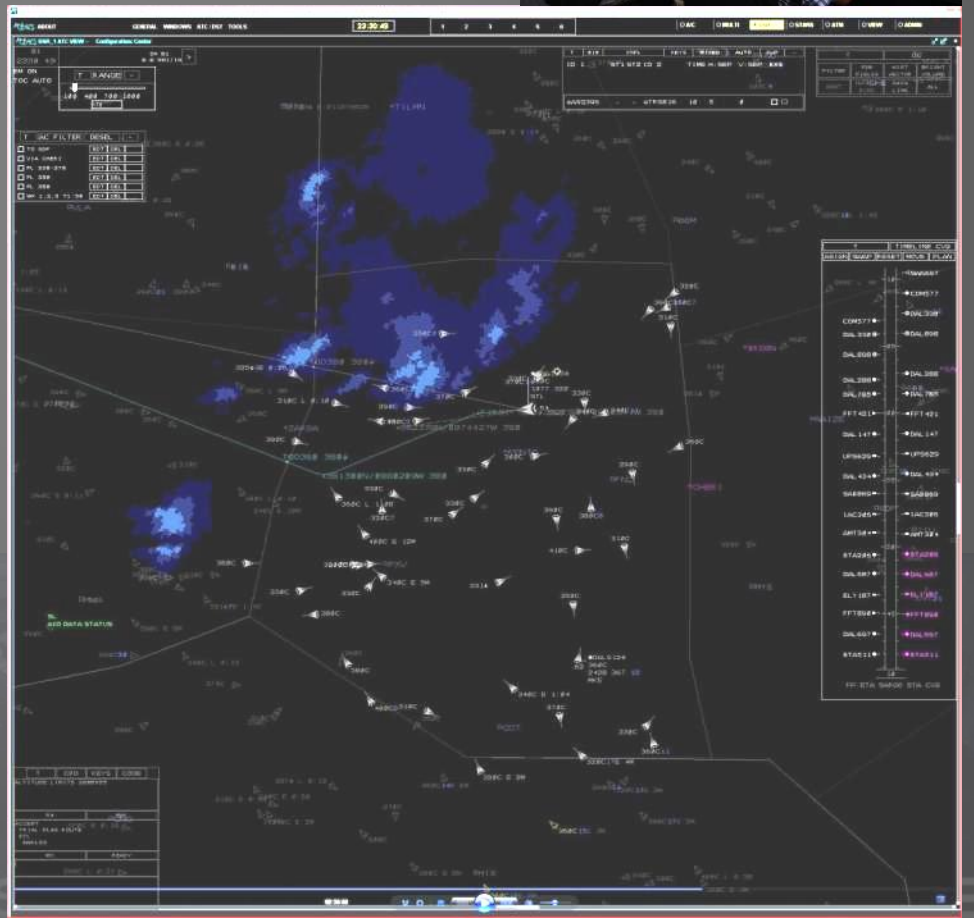


Prototype System

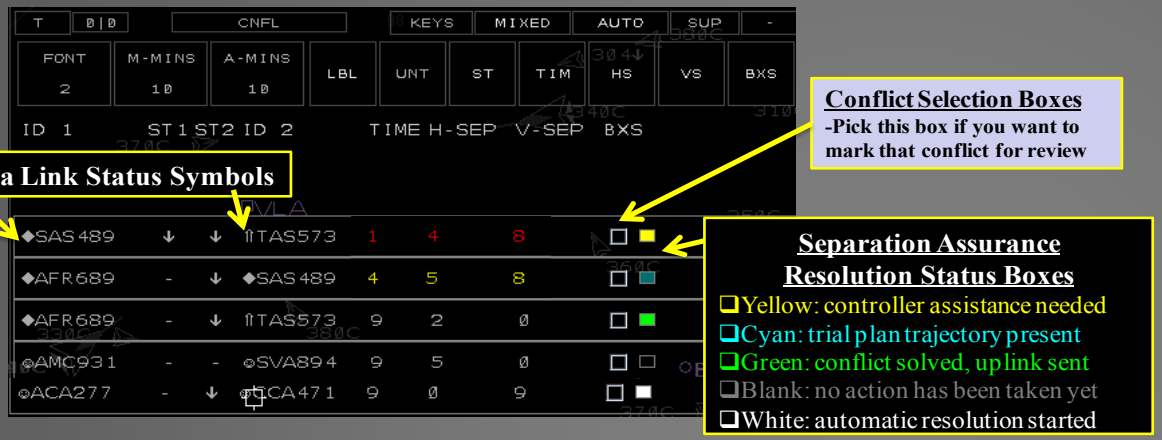
Integrated controller workstation with

- Trajectory planning
- Data communication
- Conflict probing
- Trajectory-based conflict resolution
- Short-term conflict alert and resolution
- Weather avoidance
- Scheduling and time-based metering





Trajectory-based CD&R

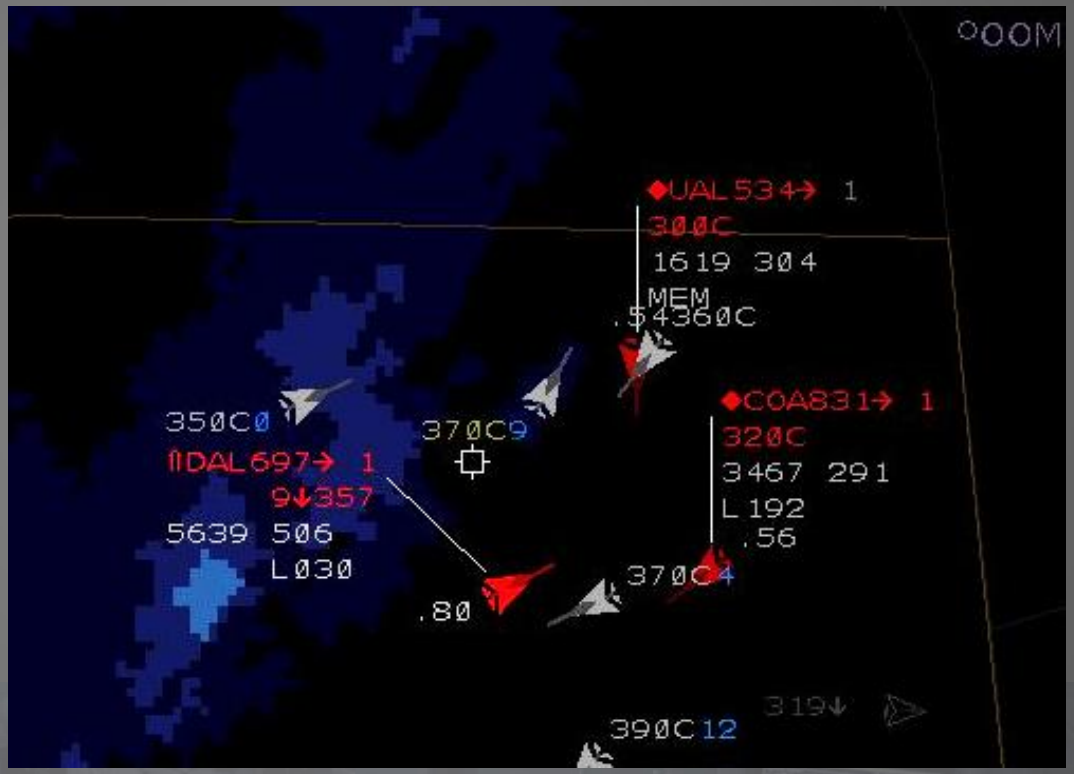


Automation status indication integrated in relevant places on the displays

(e.g. resolution, conformance data link status)

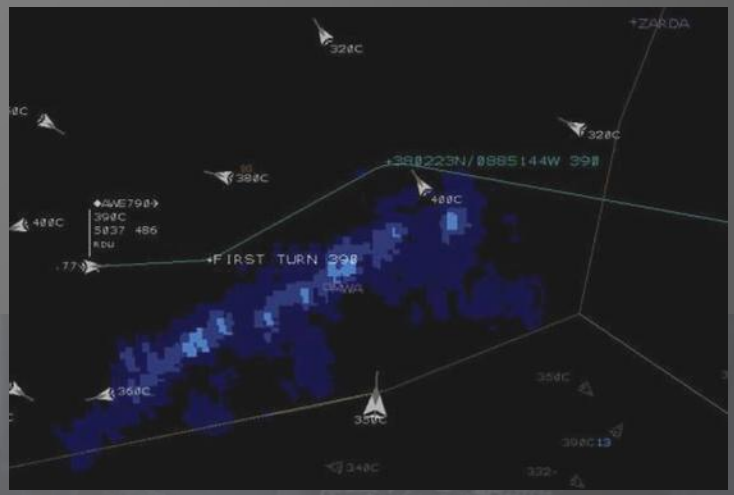
Tactical Short-Term CD&R

Vectoring solutions are highlighted in data tag and sent by the automation



Improvements

- Automation
  - Altitude fly-out menu with real-time conflict feedback
  - Free-track trajectory automation
  - Semi-automated weather avoidance
- Human Automation Interaction and Procedures



Questions?

Tom Prevot